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# A New Record of the Polychaete *Boccardia proboscidea* (Family Spionidae), Imported to Hawai'i with Oysters[1]

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ABSTRACT: The spionid polychaete *Boccardia proboscidea* Hartman, 1940 was introduced to an oyster culture farm at Keāhole, Hawai'i, with a shipment of *Ostrea edulis* from Maine. Oysters were heavily infested with adult worms, and burrows contained egg capsules with late-stage larvae. Diagnostic morphological features match the species description based on California material, except that the Hawai'i specimens are smaller. This genus differs from other oyster-associated spionids, *Polydora nuchalis* and *P. websteri,* in having blunt, bristle-tip setae on the fifth setiger. *Boccardia proboscidea* forms shallow burrows nestled under shell lamina and so differs from *P. websteri,* a true carbonate borer, and *P. nuchalis,* which builds tubes of sediment in ponds and ditches used for penaeid shrimp culture. *Boccardia proboscidea* has a pan-Pacific distribution including the west coast of North America, Japan, and southeastern Australia. This distribution is attributed in part to the production of early and late larval stages that are widely dispersed by ocean currents.

A SHIPMENT OF OYSTERS imported from Maine for culture at a Keāhole, Hawai'i, facility in March 1990 included some oysters infested with a burrowing spionid polychaete, *Boccardia proboscidea* Hartman, 1940. These spionids form mud tubes nestled under the shell lamina on the exterior surface of the valves. This species is a new record for Hawai'i's marine fauna. It is considered to be an accidental introduction and pest in a culture system.

## MATERIALS AND METHODS

Formalin-preserved oysters shells were carefully broken with forceps to remove worms from the mud under the shell lamina. Spionid polychaetes and the associated fauna were sorted and identified using dissecting and phase-compound microscopes. Specimens were illustrated from glycerol slide mounts at magnifications of 100–400×.

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## RESULTS

### *Boccardia proboscidea* Hartman, 1940

DESCRIPTION OF HAWAIIAN MATERIAL: Large specimens measure 1–1.1 mm wide across setiger 5, 1–1.3 mm long from the tip of the prostomium to the end of setiger 5 (Figure 1*a–e*); complete specimens are 6.5–12 mm long (excluding palps). The prostomium is rounded, edged with black pigment on the margins. There are three pairs of small black eyes, one of each on either side of the prostomial keel. The caruncle extends to near posterior margin of setiger 3 (Figure 1*a*), and there is no nuchal papilla.

Cirriform branchiae start on setiger 2 (Figure 1*a,b,e*), are present on setigers 3 and 4, absent from setiger 5, and then on 6, branchiae are longer from setiger 7 to the middle of the body (Figure 1*b*), then sparsely present to the posterior end. The last five to seven setigers are without branchiae. Notosetae are present on setiger 1 as setae of normal or short lengths (Figure 1*a,b,e*). Not longer than notosetae of other setigers.

Setiger 5 is modified (Figure 1*a*), with two kinds of specialized notosetae: three blunt setae with bristle tips (Figure 1*f*) and two

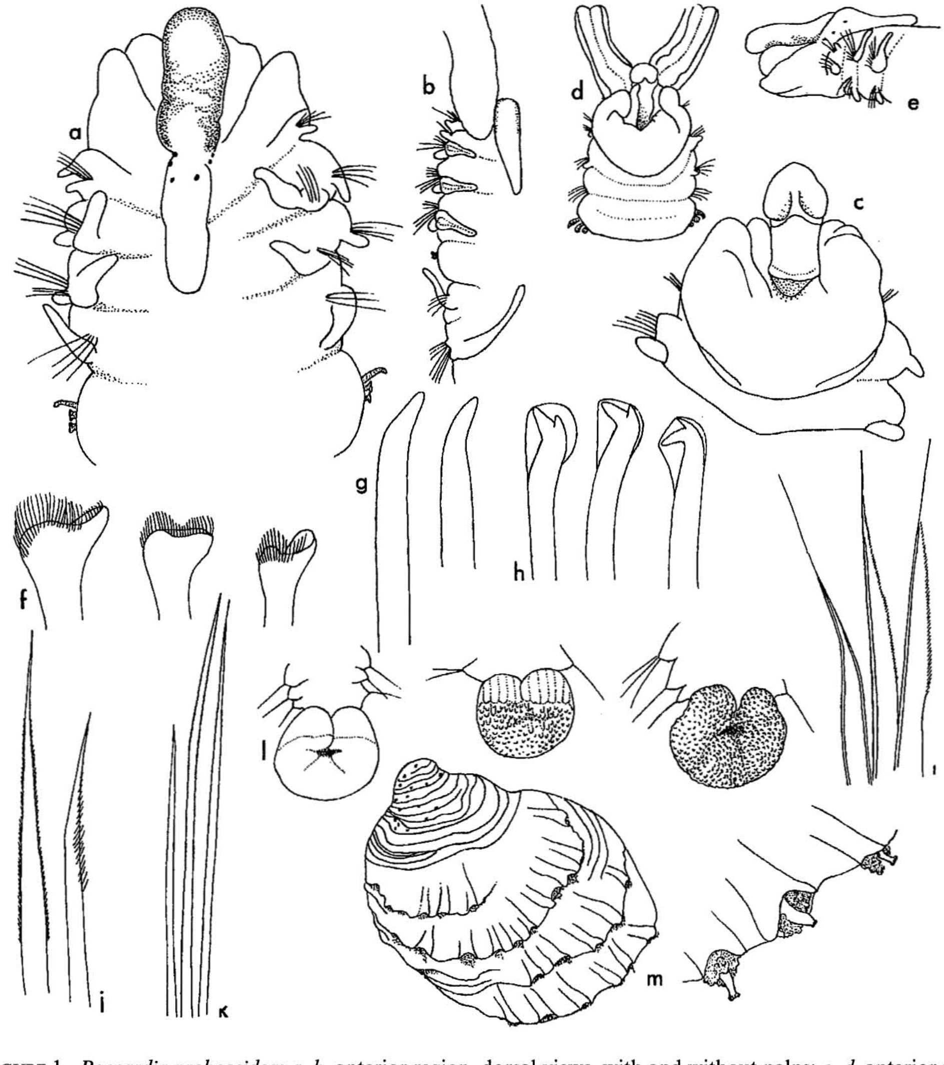


FIGURE 1. *Boccardia proboscidea: a, b,* anterior region, dorsal views, with and without palps; *c, d,* anterior region, ventral views, with and without palps; *e,* anterior region, lateral view; *f,* bristle-tip setae of setiger 5; *g,* curved setae of setiger 5; *h,* hooded hooks of setiger 7, differing views; *i,* three capillary setae of setigers 2–4; *j,* setae of middle region; *k,* setae of most posterior setigers; *l,* dorsolateral and posterior views of the pygidium; *m,* outer surface of an oyster shell valve with burrow openings in the lamina and sponge boreholes. Detail shows posterior ends protruding from the burrow openings.

heavy spines with curved tips (Figure 1*g*), one longer than the other. Tips of curved setae are directed posteriorly (Figure 1*a*).

Bidentate hooded hooks (Figure 1*h*) start on neuropodia of setiger 7 and continue to the posterior end. Hook setae vary in number from three to six per setiger in the midbody region, two to three in most posterior setigers. Hook setae without a constriction on the shaft. Neurosetae are three short capillaries. Setae of setigers 2–4 with broad-blade capillaries (Figure 1*i*), setae of middle setigers are capillaries with tapered blades (Figure 1*j*). Posterior setigers with long and short needlelike capillary setae (Figure 1*k*). Acicula are absent. Pygidium disklike or forming a cuff (Figure 1*l*), the margin divided by a conspicuous dorsal notch and in some specimens a subtle ventral indentation. Duoglands conspicuous over most of the surface of the pygidium.

The characteristic color pattern is black pigment along the margin of the cephalic ridge to above the eyes (Figure 1*a*). Faint black markings are on the dorsum of setigers 2–5. Prostomial palps each with two dark lines along their length (Figure 1*d*) on either side of the ciliary groove of some large specimens, unmarked pale buff palps in small or young worms.

REMARKS: The Hawaiian specimens agree with the description of the type specimen from California, except that they are smaller. Type material measures 30–35 mm total length (which may include the palps) and 1.5 mm wide across the anterior region (Hartman 1940).

*Boccardia proboscidea* is known from southeastern Australia (Blake and Kudenov 1978), Japan (Imajima and Hartman 1964), the Pacific coast of Canada and the United States (Light 1978, Blake 1996). Maine, on the east coast of the United States, is the source of the imported *Ostrea edulis* and is a new distributional record for *B. proboscidea.* Associated fauna with the oyster shells include the anemone *Epiactis* sp.; colonial tunicate *Botryllus* sp.; polychaetes *Terebella* sp., *Capitella capitata,* an unidentified ctenodrilid, and *Typosyllis* sp.; and encrusting boring sponge *Cliona celata.* Specimens of *Capitella capitata* were brooding embryos.

HABITAT: *Boccardia proboscidea* forms shallow burrows under the lamina of shell valves and fills the cavity with mud and oyster pseudofeces (Figure 1*m*). Position of the burrows is visible through the interior face of the valve when the shells are held up to the light. The oysters containing the spionid were maintained in raceways under marine conditions at the Ocean Thermal Energy Conversion (OTEC) facility at Keāhole, Hawai'i. The seawater comes from depths of 15 to 300 m and is considered to be pristine and ideal for aquaculture.

## DISCUSSION

The burrows are shallow and differ from those of the mud blister worm *Polydora websteri* Hartman, 1943, another spionid introduced to Hawaiian waters with oysters for extensive culture (Bailey-Brock and Ringwood 1982), which form U-shaped tubes and mud blisters in the nacreous layer of the shell. Most of the burrows of *B. proboscidea* were at the broad end of the shell (i.e., the most recently deposited part of the valve). Most oysters were infected with boring sponge in the oldest portion of the shell (Figure 1*m*). Location of spionid polychaetes in shells may be the result of the ease of burrow formation under the most recently deposited lamina.

Egg capsules containing larvae of *B. proboscidea* were found in the mud-filled burrows, indicating that reproduction had recently occurred, before collection in Maine or after placing the oysters in the grow-out facility. The spherical egg capsules are attached singly to the burrow wall; each contained late-stage larvae with specialized setiger 5 setae, hooded hooks, and capillary setae. It was not possible to distinguish early larval stages (i.e., 4 or fewer setigers) that typically occur in the egg capsules with advanced larvae and nurse eggs because of poor fixation within the capsules (Blake and Kudenov 1981, Gibson 1997).

*Polydora nuchalis* Woodwick, 1953 is another spionid polychaete accidentally brought into the Hawaiian Islands with shrimp for aquaculture. This introduction was identified in shrimp ponds in 1988, but it could have become established some time before that. The Gulf of California and western Mexico is the probable source of the worm brought to O'ahu with penaeid shrimp for culture (Bailey-Brock 1990). *Polydora nuchalis* differs from the congener *P. websteri,* which is a carbonate borer, by forming mud tubes on the pond bottom in plumbed pipes, and became a nuisance when populations reached high levels. Conditions were suitable for reproduction of *P. nuchalis,* which forms strings of egg capsules, and an extensive population grew in the land-based aquaculture farm. The ponds were emptied at the end of the shrimp grow-out phase and left drained, which may have eliminated or reduced the abundance of the spionids. Periodic rainfall allows enough water to remain in the ponds and ditches to increase the chances of survival of these tube-dwelling polychaetes. This is the most westerly record of *P. nuchalis,* which was previously known from Southern California (Blake 1996).

*Boccardia proboscidea* was introduced to Port Phillip Bay, southeastern Australia, but otherwise has a Northern-Hemisphere Pacific distribution (Blake and Kudenov 1981). This broad pan-ocean distribution is attributed in part to the production of long- and short-term larvae from benthic egg capsules.

## CONCLUSIONS

Spionid polychaetes are easily transported with oysters and shrimp for aquaculture. The polychaetes utilize the same food supplied to the oysters and sediment generated as pseudofeces or from the pond mud for constucting and lining tubes. Spionid reproduction and the early and late larval stages that develop in the tubes permit dispersal and rapid population growth under appropriate environmental conditions. Aquaculturists transport these spionids with young oysters and spat to new locations, where they can become pests at high population densities.

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